Attachment R-3. This document was originally submitted as Appendix M of the Aquifer Protection Permit Application.

Appendix M

Closure of ISR Wellfield

Closure of the ISR wellfield requires rinsing and neutralization of the portions of the formation that have been exposed to leach solution. The wells will be closed and abandoned in accordance with UIC regulations and Arizona Department of Water Resources (ADWR) guidance after rinsing has reduced all constituents to appropriate concentrations.

Metallurgical test results and geochemical modeling indicate that neutralization and constituent concentration reduction to appropriate levels can be accomplished by a three-step process (Appendix J-1). First, the acidified leaching solution is replaced with clean water to dilute the concentration of leach solution in the formation to approximately 5 percent (Appendix J-2). Second, active circulation of solutions within the subject portion of the wellfield is suspended for approximately 200 days to neutralize the acid. Metallurgical testing indicates that the leached formation will have sufficient acid neutralizing potential to raise the pH to near neutral (Appendix J-2). The third step is additional flushing with clean water to reduce regulated constituents to acceptable concentrations. The first rinsing step is expected to require three pore volumes and the second rinse (third step) is expected to require two pore volumes (Appendix J-1).

Clean water for rinsing during Stage 1 production will be provided by water supply wells. Water for rinsing Stage 2 and Stage 3 wells is anticipated to also include recycled water from a water treatment plant constructed in the later stages. Water for rinsing will be pumped from the Clean Water Pond and injected into the production wellfield. Extracted water during rinsing will be pumped to the Evaporation Pond for neutralization and disposal by natural and mechanical evaporation. The "first flush" from Step 1 rinsing is expected to contain sufficient copper grade for economical extraction in the SX-EW plant. After the copper concentration in solution drops below the economic threshold, the remainder of the rinsate extracted with be sent to the Evaporation Pond.

Rinsing is considered complete when the concentrations of all constituents are at or below acceptance criteria. Wells that are accepted as being sufficiently rinsed will be abandoned in accordance with ADWR criteria. The wells will be grouted from the bottom upward using a tremie pipe to eliminate its ability to act as a conduit for solution migration.

ISR Wellfield Closure Costs

Costs to complete the wellfield closure and abandonment process have been estimated for each year of Stage 1 production. Closure of spent portions of the wellfield is planned to take place throughout the life of the operation beginning in Year 5 when the first wells are anticipated to produce copper concentrations that fall below the economic cutoff. These costs are based on evaluating the closure cost liability at any point in Stage 1 operation, if the operation of the project were to cease.

Fixed Closure Costs

The process of rinsing the production wellfield is expected to be two years, since the time duration is dominated by the need to "rest" the wells in order to neutralize the solution. Therefore, two years of wellfield operation, maintenance, and general and administrative costs are included in the closure costs regardless of the mining year in Stage 1 that the mining operations cease.

Wellfield operations costs include direct labor and power costs. To close the wellfield at any point in time, operators will need to shut off the flow of raffinate, switch the piping for each well to be rinsed, and monitor the rinsing of all the wells that have not been completely rinsed and abandoned. While the closure schedule is spread over three years for estimating purposes, only two years are estimated to be required since the 200 day rest period between the initial and final rinse periods can be accommodated within the two-year period. Wellfield labor required to complete the rinsing of the wellfield includes one wellfield superintendent, four operators and four maintenance personnel costing $721,710 annually, or $1,443,420 for two years, as shown in Table M-1.

Table M-1: Wellfield Rinsing Fixed Costs

Department and Position	Number of Personnel	Per Person Annual Salary $	Per Person Benefits 35% $	Crew Annual Salary $	Crew Benefits $	Annual Total $
Wellfield Operations						
Wellfield Supervisor	1	65,000	22,750	65,000	22,750	87,750
Wellfield Operators	4	62,400	21,840	249,600	87,360	336,960
Wellfield Maintenance						
Wellfield Electrician	2	60,000	21,000	120,000	42,000	162,000
Wellfield Electrical Helper	2	50,000	17,500	100,000	35,000	135,000
Total Wellfield Labor	9					721,710
Wellfield Maintenance	NA					99,751
General & Administration						
Safety Specialist	1	65,000	22,750	65,000	22,750	87,750
Accountant	1	65,000	22,750	65,000	22,750	87,750
Warehouse Manager	1	60,000	21,000	60,000	21,000	81,000
Total G&A Labor	3					256,500
Non-Labor G&A Costs	60%	of G&A Labor				153,900
					Annual Total	**1,231,861**
					Number of Years	2
					Total Fixed Two Year Cost	**2,463,722**

Wellfield maintenance costs per well are estimated to be 5 percent of the equipment cost per well for each of two years of the closure rinsing operation. The maintenance costs per well averages $618.47 per injection well and $1,171.04 per recovery well, as shown in Table M-2. The maximum number of wells in operation in any year is 63 recovery wells and 42 injection wells for an estimated $99,751 per year. Two years of wellfield maintenance is estimated to be $199,502.

Table M-2: Wellfield Maintenance Costs

Item	Average Cost per well	
	Injection Well	Recovery Well
Transducer (Omega PX78)	$725.00	$725.00
Transducer Cable	$1,644.88	$1,644.88
2" FRP Injection Pipe - Solid	$2,692.80	$0.00
2" FRP Injection Pipe - Screen	$360.00	$0.00
3" FRP Drop Pipe	$0.00	$6,586.46
Submersible Pump - LARGE	$0.00	$5,745.00
Pump Cable - Large	$0.00	$1,692.74
Pump Wire Splice Kit and Strapping	$0.00	$20.00
Stainless Steel FRP Adapter 3"	$0.00	$180.00
Stainless Steel FRP Adapter - 2"	$120.00	$0.00
Instrumentation & Controls	$6,826.67	$6,826.67
Total per well	$12,369.35	$23,420.75
5% of CAPEX per well	**$618.47**	**$1,171.04**

An allowance is estimated for general and administrative costs (G&A), which include supervision labor and overhead expenses. The supervision crew will consist of a safety manager, a senior accountant, and a procurement/warehouse manager. The cost for G&A labor is estimated to be $256,500 per year ($513,000 for two years) from published

resources for southeastern Arizona and includes a burden/overhead of 35%, as shown in Table M-1. Non-labor G&A is estimated to be 60% of labor costs or $153,900 per year ($307,800 for two years) and includes light vehicles, office costs, safety equipment, insurance, maintenance supplies, communications, and outside services (Table M-1).

The total cost of labor, maintenance, and overhead (G&A) for the closure period is estimated to be $2,463,722, as shown in Table M-1. These costs are based on full time employees with benefits and management, supervision, and accounting support included in the cost of the operation. These tasks, if completed under a third-party contract, would be accomplished with administration costs built into the hourly rate as a multiplier. The total fixed costs divided by raw labor equate to a 2.0 multiplier, which is relatively high for a remediation contract.

Variable Closure Costs

Some of the wellfield closure costs are dependent on the number of wells that need to be rinsed and closed at any given point in time. Use of production wells for ISR with sulfuric acid leaching solution creates a need for rinsing, abandonment, and closure, so closure liability is considered to be accrued as soon as the wells go into production and continues until abandonment is complete. The elements of that liability for each planned annual expansion of the wellfield include water supply pumping cost for rinsing, wellfield pumping power cost, rinsate pumping power cost, mechanical evaporation power cost, and well abandonment cost for all wells in the annual production block. The rinse volume for each annual wellfield addition is the volume of the block in cubic feet times the estimated porosity (3%) times five pore volumes, and converted to gallons (from cubic feet).

Water supply costs for rinsing are based on the existing wells at the Johnson Camp Mine and the estimated power cost to pump 400 gallons per minute (gpm) divided by the flow rate requirement to accomplish the rinsing. Water supply is provided by two 60 hp pumps capable of producing 400 gpm. The cost per gallon of water supply for rinsing is $0.0002685, or $268.45 per million gallons (/Mgal) as shown in Table M-3.

Table M-3: Rinsing Water Supply Costs

Description	Units	Quantity
Water Supply output	gpm	400
Conversion	gph	24,000
Water Supply Pump motors	hp	120
Conversion	kW/hp	0.746
Power Factor	%	90
Power usage	kW	80.5
Cost per kW-hr	$	0.08
Pumping Cost per hour	$	6.44
Water Supply Power Cost	$/gal	0.0002685
Water Supply Power Cost	$/Mgal	**$268.45**

The rinse recovery pumping liability assumes a 5 hp motor capable of pumping 11 gpm per well against a total dynamic head of over 600 feet with a power cost of $0.08 per kilowatt-hour (kW-hr) to extract rinse water. The cost per gallon of rinse recovery pumping is $0.0004067, or $406.75/Mgal as shown in Table M-4.

Table M-4: Rinse Recovery Pumping Power Costs

Description	Units	Quantity
Rinse Recovery Pumping	gpm	11
Conversion	gph	660
Recovery Pump motors	hp	5
Conversion	kW/hp	0.746
Power Factor	%	90
Power usage	kW	3.4
Cost per kW-hr	$	0.08
Pumping Cost per hour	$	0.27
Rinse Recovery Pumping Cost	$/gal	0.0004067
Rinse Recovery Pumping Cost	$/Mgal	**$406.75**

Rinsate from the extraction wells reports to a collection tank from which it is pumped up to the Evaporation Pond at the Johnson Camp mine. The Early rinse water is expected to require 30 horsepower (hp) of pumping power for 200 gpm and the Late rinse water is expected to require approximately 20 hp of pumping power for 120 gpm. Maintenance for these pumps is included in wellfield maintenance (Table M-1). The unit rate for pumping early rinsate to Johnson Camp is $0.0001342 per gallon ($134.23/Mgal) and the unit rate from late rinsate is $0.0001491 per gallon ($149.14/Mgal) as shown in Table M-4.

Table M-4: Rinsate Pumping to Johnson Camp

Description	Units	Quantity
Early Rinsate Pumping to JCM	gpm	200
Conversion	gph	12,000
Recovery Pump motors	hp	30
Conversion	kW/hp	0.746
Power Factor	%	90
Power usage	kW	20.1
Cost per kW-hr	$	0.08
Pumping Cost per hour	$	1.61
Early Rinsate Pumping Cost	$/gal	0.0001342
Early Rinsate Pumping Cost	$/Mgal	**$134.23**

Late Rinsate Pumping to JCM	gpm	120
Conversion	gph	7,200
Recovery Pump motors	hp	20
Conversion	kW/hp	0.746
Power Factor	%	90
Power usage	kW	13.4
Cost per kW-hr	$	0.08
Pumping Cost per hour	$	1.07
Late Rinsate Pumping Cost	$/gal	0.0001491
Late Rinsate Pumping Cost	$/Mgal	**$149.14**

Power costs for mechanical evaporation of the rinsate is based on vendor information using climatic data for the Johnson Camp mine. The annual average evaporation expected from a single unit operating 6,480 hours per year at 16 kW is 8,318,000 gallons. Flow rates for rinsing and evaporation assume that the volume of water required for rinsing is divided by the number of minutes in a calendar year. The unit rate for evaporation is $0.0009972 per gallon, or $997.16 per million gallons as shown in Table M-5.

Table M-5: Evaporation Power Costs

Description	Units	Quantity
Annual Evaporation Rate	year	8,318,000
6,480 operation hours per year	gph	1,284
Power usage	kW	16.0
Cost per kW-hr	$	0.08
Pumping Cost per hour	$	1.28
Evaporation Power Cost	$/gal	0.0009972
Evaporation Power Cost	$/Mgal	**$997.16**

Confirmation sampling is proposed at the end of late rinsing to confirm that the rinsing has effectively reduced regulated constituents to acceptance concentrations prior to abandonment of the wells. Approximately 10 percent of the recovery wells in each rinsing block will be sampled prior to abandonment. The samples will be collected from the recovered rinsate near the end the late rinsing cycle and submitted to a laboratory that is certified by the State of Arizona for the analyses performed. The cost of sampling, analyses, and reporting is estimated to be $1,631.50 per sample, as shown in Table M-6. A liability for verification sampling accrues when recovery wells are installed and put into production. Credits are accrued against that liability when the wells are scheduled to be sampled and closed. Table M-7 shows the yearly and cumulative liabilities and credits for verification sampling of rinsed blocks.

Table M-6: Verification Sampling Cost

Item	Quantity	Rate	Unit	Total
Staff time (hours to collect 3 samples)	1.5	$95.00	hr	$142.50
Field parameters meter	3	$25.00	day	$75.00
Laboratory cost (short list of analytes)				
Dissolved metals (Sb, As, Ba, Be, Cd, Cr, Pb, Se, Th, Ni)	3	$161.00		$483.00
Mercury dissolved	3	$41.00		$123.00
Sulfate	3	$15.00		$45.00
Fluoride	3	$20.00		$60.00
VOCs	3	$150.00		$450.00
TDS	3	$21.00		$63.00
pH--field	3	$0.00		$0.00
nitrate + nitrite	3	$30.00		$90.00
Data Management	1	$100.00	Hr	$100.00
Rinse Verification Sampling Total				**$1,631.50**

Assumptions:

No purging required. Samples collected near end of early rinsing and at beginning and end of late rinsing.
Propose that 10% of recovery wells be monitored during rinsing.
Prepared by Clear Creek Associates using current field staff rates, analytical costs provided by Turner Laboratories.

Table M-7: Verification Sampling of Rinsed Blocks

Rinse Verification Liabilities and Credits	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Recovery Wells Installed	28	41	52	63	48	51	48	48	48	53
Number of samples (10%)	3	5	6	7	5	6	5	5	5	6
Rinse Verification Liability per Year[1]	**$4,895**	**$8,158**	**$9,789**	**$11,421**	**$8,158**	**$9,789**	**$8,158**	**$8,158**	**$8,158**	**$9,789**
Recovery Wells Closed	-	-	-	-	-	-	-	18	9	10
Number of samples (10%)	-	-	-	-	-	-	-	2	1	1
Rinse Verification Credits per Year[1]	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**($3,263)**	**($1,632)**	**($1,632)**
Cumulative Rinse Verification Liability/Credits	**$4,895**	**$13,052**	**$22,841**	**$34,262**	**$42,419**	**$52,208**	**$60,366**	**$65,260**	**$71,786**	**$79,944**

[1]**Note:** Sampling and analysis cost per well estimated at $1,631.50

Well abandonment liability is based on estimates provided by Kinley Exploration (Kinley) for the prefeasibility study (M3 Engineering & Technology Corp., 2014) in accordance with the methodology presented in Section 7. Costs for abandonment are based on the well diameter (in inches) and depth of the well (in feet). Fixed costs for labor and equipment are included in the footage rate, which is dominated by the cost of the cement grout. Liability for well abandonment is accrued when the wells are constructed and credited against that liability when closure is completed. The liabilities and credits shown in Table M-8 are in accordance with the proposed production schedule.

Table M-8: Well Abandonment Costs

Well Abandonment Liabilities and Credits	Cost per ft.	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
6" Well footage drilled		84,646	34,432	28,499	24,389	25,824	28,693	30,128	30,128	27,259	28,693
5" Well footage drilled		-	-	2,481	6,202	-	-	2,481	-	-	-
4" Well footage drilled		2,869	1,435	1,435	-	-	-	-	-	-	1,435
6" Well Abandonment liability	$5.44	$ 460,071	$ 187,148	$ 154,901	$ 132,563	$ 140,361	$ 155,956	$ 163,754	$ 163,754	$ 148,158	$ 155,956
5" Well Abandonment liability	$4.73	$ -	$ -	$ 11,742	$ 29,354	$ -	$ -	$ 11,742	$ -	$ -	$ -
4" Well Abandonment liability	$4.79	$ 13,732	$ 6,866	$ 6,866	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,866
Abandonment Liability per Year		**$473,803**	**$194,013**	**$173,508**	**$161,917**	**$140,361**	**$155,956**	**$175,496**	**$ 163,754**	**$ 148,158**	**$ 162,822**
6" Well footage abandoned		-	-	-	-	-	-	-	84,646	34,432	28,499
5" Well footage abandoned		-	-	-	-	-	-	-	-	-	2,481
4" Well footage abandoned		-	-	-	-	-	-	-	2,869	1,435	1,435
6" Well Abandonment credits	$5.44	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$(460,071)	$(187,148)	$(154,901)
5" Well Abandonment credits	$4.73	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (11,742)
4" Well Abandonment credits	$4.79	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (13,732)	$ (6,866)	$ (6,866)
Abandonment Credits per Year		**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$(473,803)**	**$(194,013)**	**$(173,508)**
Cumulative Abandonment Liability/Credits		**$ 473,803**	**$ 667,816**	**$ 841,324**	**$1,003,241**	**$1,143,602**	**$1,299,558**	**$1,475,054**	**$1,165,005**	**$1,119,150**	**$1,108,464**

Table M-9: Stage 1 Cumulative Wellfield Closure Liability by Production Year

Category	Rate	Unit	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Rinse volume for added block		gallons	144,578,467	86,747,080	77,108,515	67,469,951	86,747,080	86,747,080	77,108,515	77,108,515	86,747,080	77,108,515
Water Supply Power Liability	$268	$/Mgal	$38,812	$23,287	$20,700	$18,112	$23,287	$23,287	$20,700	$20,700	$23,287	$20,700
Rinse Recovery Pumping Power Liability	$407	$/Mgal	$58,807	$35,284	$31,364	$27,443	$35,284	$35,284	$31,364	$31,364	$35,284	$31,364
Early Rinsate Pumping Liability	$134	$/Mgal	$19,406	$11,644	$10,350	$9,056	$11,644	$11,644	$10,350	$10,350	$11,644	$10,350
Late Rinsate Pumping Liability	$149	$/Mgal	$21,562	$12,937	$11,500	$10,062	$12,937	$12,937	$11,500	$11,500	$12,937	$11,500
Evaporation Power Liability	$997	$/Mgal	$144,168	$86,501	$76,890	$67,279	$86,501	$86,501	$76,890	$76,890	$86,501	$76,890
Rinse Verification Liability	SeeTable N-6	$	$4,895	$8,158	$9,789	$11,421	$8,158	$9,789	$8,158	$8,158	$8,158	$9,789
Well abandonment Liability	See Table M-7	$	$473,803	$194,013	$173,508	$161,917	$140,361	$155,956	$175,496	$163,754	$148,158	$162,822
	Yearly Closure Liability		$761,453	$371,824	$334,100	$305,290	$318,172	$335,399	$334,456	$322,715	$325,970	$323,414
Water Supply Power Credits							-23,287	-13,972	-27,945	-20,182	-22,252	-21,217
Rinse Recovery Pumping Power Credits							-35,284	-21,170	-42,341	-30,579	-33,716	-32,148
Early Rinsate Pumping Credits							-19,406	-11,644	-10,350	-9,056	-11,644	-11,644
Late Rinsate Pumping Credits									-21,562	-12,937	-11,500	-10,062
Evaporation Power Credits							-86,501	-51,901	-103,801	-74,967	-82,656	-78,812
Rinse Verification Credits										-3,263	-1,632	-1,632
Well abandonment Credits										-473,803	-194,013	-173,508
	Yearly Closure Credits		$0	$0	$0	$0	-$164,479	-$98,687	-$205,999	-$624,789	-$357,413	-$329,023
Cumulative Wellfield Closure Liability less Credits			**$761,453**	**$1,133,278**	**$1,467,378**	**$1,772,668**	**$1,926,361**	**$2,163,073**	**$2,291,530**	**$1,989,456**	**$1,958,012**	**$1,952,403**
Wellfield Closure Fixed Costs (Labor, Maintenance, and G&A)			$2,463,722	$2,463,722	$2,463,722	$2,463,722	$2,463,722	$2,463,722	$2,463,722	$2,463,722	$2,463,722	$2,463,722
Total Wellfield Closure Liability less Credits with Fixed Costs			**$3,225,175**	**$3,597,000**	**$3,931,100**	**$4,236,390**	**$4,390,083**	**$4,626,795**	**$4,755,252**	**$4,453,178**	**$4,421,734**	**$4,416,125**

ISR Wellfield Closure Credits

The process of closing production wells is scheduled to begin in Year 5 of production. The first step in closure of production wells is early rinsing in which the leaching solution is replaced with clean water to dilute the pore water in the formation approximately 95 percent. Geochemical studies (Appendix J-1) indicate that this will require injection of approximately three pore volumes of clean water. When this has been accomplished, the closure liability is reduced by the cost of that rinsing and is shown as a credit (Table M-9). The early rinsing credit is calculated as three-fifths of the rinsing liability, since it involves three of the five pore volumes necessary to complete the rinsing.

Additional rinsing is conducted to reduce all constituents to acceptable concentrations after neutralizing the rinsed solution in the formation for at least 200 days (approximated as a year in the closure schedule). The rinsing credit for this late rinsing is the remaining two-fifths of the water supply, rinsate extraction pumping, rinsate pumping, and evaporation liability. Rinsing verification sampling credits are accrued when verification sampling confirms all constituents are at acceptable concentrations.

Well abandonment is the final stage in the closure process. Well abandonment credits begin in Year 8 when the final rinsing has been completed and the water quality in the rinsing block has been verified as meeting acceptance criteria. It is assumed that all wells in an annual block would be abandoned within the year after late rinsing.

Cumulative Closure Liability

The final row in Table M-9 shows the cumulative wellfield liability with deductions for closure expenses projected to have been accrued to that point on a year-by-year basis. The closure liability for Stage 1 production peaks in Year 7 at $2.29 million. When the labor, maintenance, and general and administrative costs for two years of closure rinsing operations at $2.46 million are added in, the total maximum liability for wellfield closure is estimated to be $4.76 million.

References

M3 Engineering & Technology Corp., 2014. Gunnison Copper Project, NI 43-101 Technical Report, Prefeasibility Study, Cochise County, Arizona, USA. February 14, 2014.